

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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PCT

## NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

Date of mailing  
(day/month/year)

14.06.2005

Applicant's or agent's file reference <b>29143-49</b>	<b>IMPORTANT NOTIFICATION</b>	
International application No. <b>PCT/US2004/018594</b>	International filing date (day/month/year) <b>10.06.2004</b>	Priority date (day/month/year) <b>11.06.2003</b>
Applicant <b>PORVAIR PLC</b>		

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Delmon, G Tel. +31 70 340-2525
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**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)  
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 29143-49	<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/US2004/018594	International filing date (day/month/year) 10.06.2004	Priority date (day/month/year) 11.06.2003	
International Patent Classification (IPC) or national classification and IPC C22B9/05, C22B21/06, B22D1/00, C21C7/00			
Applicant <b>PORVAIR PLC</b>			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of 3 sheets, as follows:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</li> <li><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</li> </ul> <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the opinion</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>			
Date of submission of the demand 17.03.2005	Date of completion of this report 14.06.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Bombeke, M Telephone No. +31 70 340-3576		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/018594

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
    - international search (under Rules 12.3 and 23.1(b))
    - publication of the international application (under Rule 12.4)
    - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

**Description, Pages**

1-11 as originally filed

**Claims, Numbers**

1-31 filed with the demand

**Drawings, Sheets**

1/5-5/5 as originally filed

a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3.  The amendments have resulted in the cancellation of:
  - the description, pages
  - the claims, Nos.
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):
4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
  - the description, pages
  - the claims, Nos.
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/018594

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-31
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-31
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-31
	No:	Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

**PCT/US2004/018594**

**Re Item V.**

1 The following document is referred to in this communication:

D1 : PATENT ABSTRACTS OF JAPAN vol. 010, no. 219 (C-363), 31 July  
1986 (1986-07-31) & JP 61 056257 A (JAPAN METALS & CHEM CO LTD), 20  
March 1986 (1986-03-20)

**2 INDEPENDENT CLAIMS 1 AND 25**

The subject-matter of claim 1 resp. 25 concerns a degasser device resp. an apparatus for purifying molten metal, characterized by comprising a microporous plate including first and second internal passageways with first and second nonporous interface tubes attached to said microporous plate in flow communication with said first and second internal passageways.

Such a plate-shaped degasser device is not taught in closest prior art document D1, which recites a microporous degasser element of single tube design.

Furthermore, said document nor any other citation of the ISR does contain any indication or hint to the possibility, feasibility and usefulness of providing multiple passageways and interface tubes for degassing/purifying molten metal.

Hence the devices defined in independent claims 1 and 25 are novel in the sense of Art. 33(2) PCT and do involve an inventive step in the sense of Art. 33(3) PCT.

2.1. Claims 2-12 resp. 26-31 are dependent on claim 1 resp. 25 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

**3 CLAIMS 13-24**

Claim 13 to a "method" of purifying molten metal differs from D1 (which discloses the immersion of a microporous "pipe" in the molten metal to be degassed and evacuating the pipe to exhaust the gas in the melt through the porous wall of the pipe) in that a microporous "plate" with interface tube connection is used and in that a purge gas is passed into said microporous plate. D1 does not contemplate or suggest the use of a purge gas in connection with pipe evacuation.

It follows that the subject-matter of independent claim 13, and thus also of dependent

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.  
**PCT/US2004/018594**

claims 14-24, is novel (Article 33(2) PCT) and inventive (Art. 33(3) PCT).

## CLAIMS

Claimed is:

1. A degasser for molten metal comprising:  
5 a microporous plate comprising a first internal passageway and a second internal passageway;  
a first nonporous interface tube attached to said microporous plate in flow communication with said first internal passageway and a second nonporous interface tube in flow communication with said second internal passageway.
2. The degasser of claim 1 wherein said first nonporous interface tube introduces  
10 an inert gas to said first internal passageway.
3. The degasser of claim 1 wherein said second internal passageway and said first internal passageway form a cavity.
4. The degasser of claim 1 wherein said microporous plate has a critical  
15 metallostatic pressure ( $H_p$ ) for penetration by aluminum at a predetermined operating depth defined by the equation:

$$H_p > 4 \gamma_{is} (\cos \theta) / g \rho \phi$$

wherein:

$\gamma_{is}$  is interfacial surface energy between said microporous plate and said metal,

20  $\theta$  is contact wetting angle of molten metal on said microporous plate,

$g$  is Newton's constant,

$\rho$  is the liquid metal density and

$\phi$  is the pore opening size of said microporous plate.

5. The degasser of claim 1 wherein said microporous plate comprises passages.
- 25 6. The degasser of claim 1 wherein said passages have an equivalent diameter of at least about 500 microns to no larger than about 50 mm.
7. The degasser of claim 6 wherein said passages have an equivalent diameter of at least about 5 mm to no more than about 7.5 mm.
8. The degasser of claim 5 wherein said passages are separated by a distance  
30 between about 0.5 to 10 times an equivalent diameter of said passage.
9. The degasser of claim 1 wherein said microporous plate is about 3 mm to about 200 mm thick.
10. The degasser of claim 1 further comprising a containment vessel with said microporous plate contained in said containment vessel.

11. The degasser of claim 10 further comprising a filter in said containment vessel.
12. The degasser of claim 1 further comprising a monitor in flow communication with said first interface tube for monitoring gases flowing therethrough.
13. A method for purifying molten metal comprising the steps of:  
5 melting metal to form molten metal;  
passing said molten metal through a containment vessel wherein said containment vessel comprises a degasser and wherein said degasser comprises a microporous plate comprising at least one internal passageway and a nonporous interface tube attached to said microporous plate in flow communication with said internal passageway;  
10 passing a purge gas into said microporous plate; and  
removing hydrogen from said microporous plate through said interface tube.
14. The method for purifying metal of claim 13 wherein said containment vessel further comprises a filter.
15. The method for purifying metal of claim 14 wherein said metal passes through said microporous plate prior to passing through said filter.
16. The method for purifying metal of claim 13 wherein said microporous plate has a critical metallostatic pressure ( $H_p$ ) defined by the equation:

$$H_p > 4 \gamma_{is} (\cos \theta) / g \rho \phi$$

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wherein:

$H_p$  is critical pressure for capillary penetration,

$\gamma_{is}$  is interfacial surface energy between said microporous plate and said metal,

$\theta$  is contact wetting angle of molten metal on said microporous plate,

$g$  is Newton's constant,

$\rho$  is the liquid metal density and

$\phi$  is the pore opening size of said microporous plate.

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17. The method of claim 13 wherein said hydrogen is removed by vacuum applied to said interface tube.
18. The method of claim 13 wherein said hydrogen is removed by flowing a purge gas through said degasser.
19. The method of claim 13 wherein said microporous plate comprises passages.
20. The method of claim 19 wherein said passages have an equivalent diameter of at least about 500 microns to no larger than about 50 mm.

21. The method of claim 20 wherein said passages have an equivalent diameter of at least about 5 mm to no more than about 7.5 mm.
22. The method of claim 19 wherein said passages are separated by a distance between about 0.5 to 10 times an equivalent diameter of said passage.
- 5 23. The method of claim 13 wherein said microporous plate is about 3 mm to about 200 mm thick.
24. The method of claim 13 wherein said degasser further comprising a monitor in flow communication with said interface tube for monitoring gases flowing therethrough.
- 10 25. An apparatus for purifying molten metal comprising:  
a containment vessel comprising an inlet throat and an outlet throat; and  
a degasser between said inlet throat and said outlet throat wherein said degasser comprises a microporous plate comprising at least one internal passageway and at least two nonporous interface tubes attached to said microporous plate in flow communication with said internal passageway.
- 15 26. The apparatus for purifying metal of claim 25 further comprising a filter.
27. The apparatus for purifying metal of claim 26 wherein said filter is between said degasser and said outlet throat.
28. The apparatus for purifying metal of claim 26 further comprising an equalization space between said degasser and said filter.
- 20 29. The apparatus of claim 25 wherein said outlet throat comprises a first transition region comprising a downward sloping floor and a drain in said floor.
30. The apparatus of claim 29 wherein said outlet throat further comprises a second transition region comprising an upward sloping floor.
- 25 31. The apparatus of claim 24 further comprising a monitor in flow communication with an interface tube for monitoring gases flowing therethrough.